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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,752	03/29/2004	Gerald H. Negley	5000.197	2834
21176	7590	03/15/2006	EXAMINER	
SUMMA, ALLAN & ADDITON, P.A. 11610 NORTH COMMUNITY HOUSE ROAD SUITE 200 CHARLOTTE, NC 28277			LANDAU, MATTHEW C	
			ART UNIT	PAPER NUMBER
			2815	

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Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b> 10/811,752	<b>Applicant(s)</b> NEGLEY, GERALD H.	
	<b>Examiner</b> Matthew Landau	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 January 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-44 is/are pending in the application.
- 4a) Of the above claim(s) 6 and 19-44 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-11 and 13-18 is/are rejected.
- 7) ☒ Claim(s) 12 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>9/16/04</u> . | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Election/Restrictions***

Applicant's election without traverse of Group I, claims 1-5 and 7-18, in the reply filed on January 6, 2006, is acknowledged.

Claims 6 and 19-44 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

### ***Drawings***

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "plurality of silicon dioxide portions on said p-type Group III nitride layer" (claim 11) must be shown or the feature(s) canceled from the claim(s). Note that Figure 3 shows a plurality of silicon dioxide portions on an n-type layer 16. No p-type layer is present in Figure 3. Also, "said second silicon dioxide layer is limited to said source composition portions" (claim 12) must be shown or the feature(s) canceled from the claim(s). Note that Figure 3 shows the second SiO<sub>2</sub> layer 14 is formed over the entire area, not just the source composition portions. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must

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be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 7 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7 recites the limitation "said substrate". There is insufficient antecedent basis for this limitation in the claim. For the purposes of this Office Action, it will be considered that claim 7 depends from claim 2 instead of claim 1.

Regarding claim 10, it is unclear how a gallium nitride layer can have the formula  $\text{Ga}_x\text{Al}_y\text{In}_{1-x-y}$ . A gallium nitride layer must have N in the formula. For the purposes of this Office Action, it will be considered that the formula is  $\text{Ga}_x\text{Al}_y\text{In}_{1-x-y}\text{N}$ .

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-5, 8, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy (US Pat. 3,925,121) in view of Ogihara et al. (US Pat. 5,700,714, hereinafter Ogihara).

Regarding claims 1 and 5, Touchy discloses a p-type gallium nitride-based device comprising: a device structure that includes at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Mg or Zn) on said first SiO<sub>2</sub> layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Mg or Zn composition) is in the form of a solid layer. The difference between Touchy and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO<sub>2</sub> cap layer 22 (col. 4, lines 3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by including a second SiO<sub>2</sub> layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

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Regarding claim 3, Touchy discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO<sub>2</sub> layer) (col. 5, lines 16-29). Therefore, the first SiO<sub>2</sub> layer must be thick enough to create vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse thereinto while still permitting diffusion from said Group II metal source composition.

Regarding claim 4, Touchy discloses the first SiO<sub>2</sub> layer is in the range of 500-1500 angstroms. Touchy does not specifically disclose the first SiO<sub>2</sub> layer is about 1000 angstroms thick, the Group II metal source composition layer is about 1000 angstroms thick, and the second SiO<sub>2</sub> layer is about 2500 angstroms thick. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify Touchy by selecting the claimed thickness values, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 8, it is inherent that the metal source composition layer of Touchy comprises some type of metal-containing compound.

Regarding claim 10, Touchy discloses the Group II metal source composition layer is GaN, which reads on the claim when x=1 and y=0 (col. 2, lines 30-35).

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara as applied to claim 1 above, and further in view of Edmond et al. (US Pat. 5,523,589, hereinafter Edmond).

Regarding claim 2, Touchy discloses the p-type semiconductor layer is used in an electroluminescent semiconductor device (col. 1, lines 47-50). A further difference between Edmond and the claimed invention is the device comprises a conductive silicon carbide substrate; a conductive buffer layer on said silicon carbide substrate; and an n-type Group III nitride layer on said buffer layer. Figure 1 of Edmond discloses a light-emitting device comprising a SiC substrate 21, a conductive buffer layer 23 on said substrate; and an n-type Group III nitride layer 27 on said buffer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by using the structure of Edmond for the purpose of fabricating a LED that can emit blue light and can be built in the vertical geometry (col. 3, lines 52-57 of Edmond).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Iguchi et al. (US Pat. 6,214,708, hereinafter Iguchi).

Regarding claim 9, a further difference between Touchy and the claimed invention is the compound is selected from the group consisting of magnesium nitride and zinc phosphide. Iguchi discloses doping a III-V semiconductor with Zn by using zinc phosphide (col. 9, lines 48-52). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by using zinc phosphide as the diffusion source material for the purpose of selecting a well known diffusion source zinc compound.

Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Nobori et al. (US Pat. 6,291,328, hereinafter Nobori).

Regarding claim 11 and 13, a further difference between Touchy and the claimed invention is a plurality of silicon dioxide portions on said p-type Group III nitride layer, with a respective portion of said source composition on each said silicon dioxide portion. Figures 1 and 2 of Nobori discloses an array of LED's (shown as hatched portions in Figure 1), wherein each LED has a diffusion area 15 and a diffusion source layer 12 over the diffused area. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by having a plurality of separate diffusion areas, wherein each area is covered by a separate diffusion source layer. The ordinary artisan would have been motivated to modify Touchy in the manner described above for the purpose of fabricating a plurality of LED's on the same substrate. Regarding 13, it would also be obvious to have the second silicon dioxide layer (diffusion cap layer) covering said source composition portions and portions of the p-type Group III nitride layer as taught by Nobori (element 14 in Figure 2), for the purpose of simplifying the production process.



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Claims 1, 2, 7, and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Omi et al. (US Pat. 6,549,552, hereinafter Omi) in view of Touchy and Ogihara.

Regarding claims 1, 2, and 14, Figure 1 of Omi discloses a light emitting device comprising: a conductive silicon carbide substrate 1; a conductive buffer layer 2 on said silicon carbide substrate for provided a crystal transition between said substrate and said GaN portions of said device; an n-type GaN layer 3 on said buffer layer; and an Mg-doped p-type GaN layer 9 (col. 9, lines 14-16) on said n-type layer. A difference between Omi and the claimed invention is a first silicon dioxide layer on said p-type layer; a magnesium layer on said first SiO<sub>2</sub> layer for supplying p-type dopant to said p-type layer. Touchy discloses a method of p-doping a GaN layer wherein an intermediate product comprises at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Zn or Mg) on said first SiO<sub>2</sub> layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Zn or Mg composition) is in the form of a layer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Omi by doping the p-GaN layer using the method of Touchy, and therefore the intermediate structure of Touchy (comprising an SiO<sub>2</sub> layer over the p-GaN layer, and a diffusion source layer over the SiO<sub>2</sub> layer). Touchy also discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO<sub>2</sub> layer) (col. 5, lines 16-29). Therefore, the first SiO<sub>2</sub> layer must be thick enough to create vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse

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thereinto while still permitting diffusion from said Group II metal source composition. The limitation “when said device is heated to temperatures between about 750 and 950 degrees” is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The ordinary artisan would have been motivated to modify Omi in the manner described above for the purpose of selecting inexpensive and well-known process for implanting Mg into the p-layer of Omi. A further difference between Omi and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO<sub>2</sub> cap layer 22 (col. 4, lines 3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by including a second SiO<sub>2</sub> layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

Regarding claims 7 and 15, Figure 1 of Omi discloses the substrate 1 is n-type (col. 4, lines 25-27). Further regarding claim 8, Omi does not specifically disclose the substrate has a carrier concentration of between about  $1 \times 10^{16} \text{ cm}^{-3}$  and about  $1 \times 10^{19} \text{ cm}^{-3}$ . However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the invention of Omi by using a carrier concentration within the claimed range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 16, Figure 1 of Omi discloses the buffer layer 2 is a homogeneous layer of GaN (col. 4, lines 26-28).

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Regarding claim 17, Figure 1 of Omi discloses the n-type layer 3 comprises AlGa<sub>N</sub> (col. 4, lines 28-30) (when  $y=0$ ).

Regarding claim 18, Figure 1 of Omi discloses the p-type layer 9 comprises Ga<sub>N</sub> (col. 4, lines 33-35) (when  $x=1$  and  $y=0$ ).

### ***Allowable Subject Matter***

Claim 12 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is (571) 272-1731.

The examiner can normally be reached from 8:30 AM - 5:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300 for regular communications and (571) 273-8300 for After Final communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

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may be obtained from either Private or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should any questions arise regarding access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Matthew C. Landau

March 13, 2006